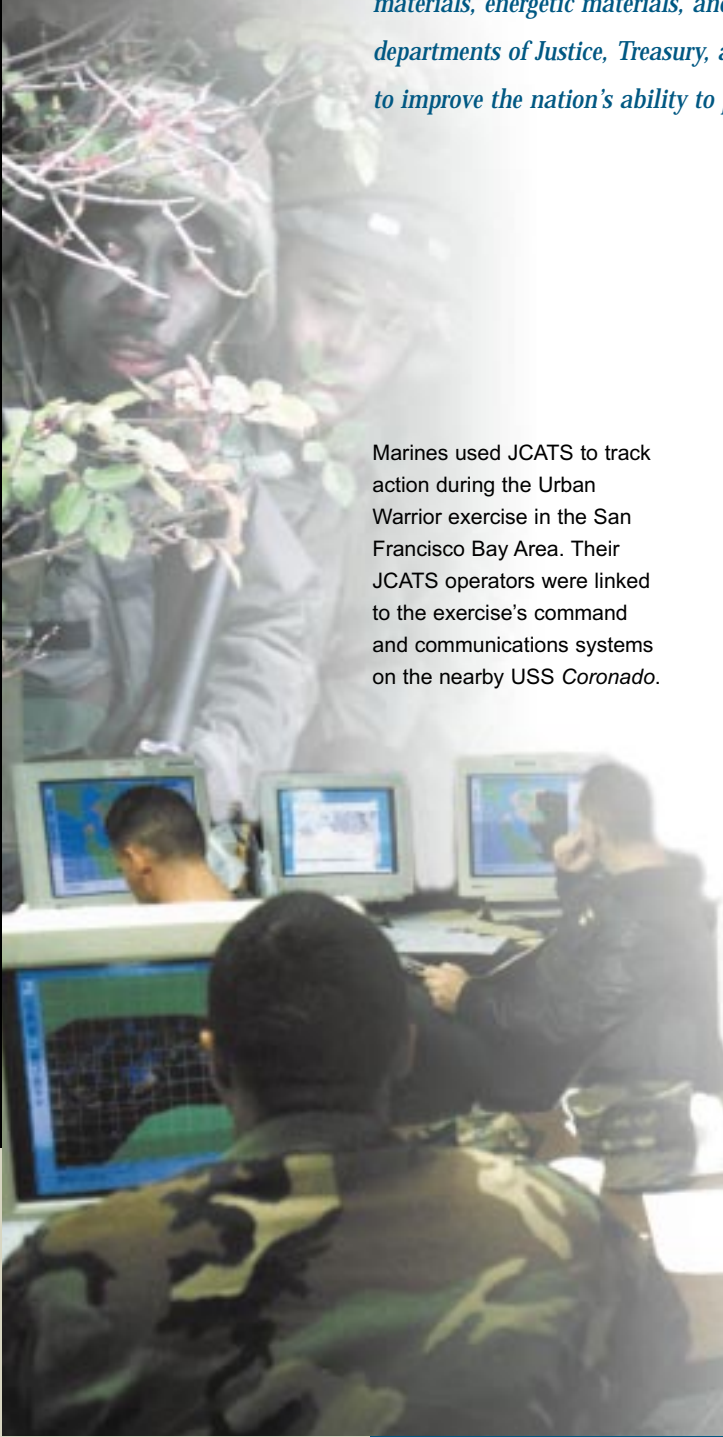


Response to Proliferation and Other Security Threats

We work with the Department of Defense (DoD) to leverage the Laboratory's capabilities to meet a variety of national security challenges. In addition to our nonproliferation efforts, Livermore makes technological advances in such areas as missile defense, solid-state lasers, armor and antiarmor materials, energetic materials, and conflict simulation. We also work with other agencies, including the departments of Justice, Treasury, and Commerce, to respond to the 1998 Presidential Decision Directive to improve the nation's ability to prevent and mitigate attacks by terrorists using WMD.



Marines used JCATS to track action during the Urban Warrior exercise in the San Francisco Bay Area. Their JCATS operators were linked to the exercise's command and communications systems on the nearby USS *Coronado*.

Technology to Support Military Operations

In March 1999, two sophisticated computer tools developed at Livermore provided support to the Navy's Fleet Battle Experiment and the Marine Corps' Urban Warrior exercise. The Counterproliferation Analysis and Planning System (CAPS) provided real-time plume dispersal models associated with simulated chemical and biological attacks by terrorists against the 3rd Fleet and the City of Oakland. Used by U.S. combatant commands around the world, CAPS is an easy-to-use, powerful system for end-to-end process analysis of a proliferator's WMD production capabilities and for assessment of interdiction options and corresponding consequences.

The Joint Conflict and Tactical Simulation (JCATS) model supported Urban Warrior by providing a virtual

battlefield context for the Marine Corps' live exercise. The culmination of our long experience in conflict simulation, JCATS has become a standard for simulation activities used by more than 50 organizations—including U.S. military, the State Department, the Secret Service, and DOE's site-security function. JCATS allows training, planning, and tactics analysis from the campaign level (hundreds of square kilometers) to individuals fighting inside a multistory building. Version 2.0 of JCATS was delivered to the Atlantic Command's Joint WarFighting Center in October 1999.

Fast, Accurate, and Portable Biodetectors

As part of DOE's Chemical and Biological Nonproliferation Program, Livermore has developed unique instruments to dramatically advance biological agent detection capabilities. Our miniature flow cytometer uses our patented flow-stream-waveguide design, which



Applied on the left side of the petri dish, L-Gel effectively inhibits the germination of *Bacillus globigii* spores (surrogate for anthrax). Livermore's latest polymerase chain reaction (PCR) instrument (right), the HANAA, detects key biological agents.

permits the development of field-portable instruments. This past year, we demonstrated multiplex (simultaneous) detection of a suite of biological organisms and compounds (bacteria, bacterial spore, protein, and virus) using flow cytometry.

Two optimized polymerase chain reaction (PCR) instruments—the Advanced Nucleic Acid Analyzer (ANAA) and, most recently, the Handheld ANAA (HANAA)—have demonstrated a high probability of detecting even a single target DNA strand in a sample. Both instruments can detect key biological agents in 7 minutes, a breakthrough made possible through extreme miniaturization of the thermal cycling chamber. Versions of the ANAA have been delivered to the Naval Medical Research Center and the U.S. Army Medical

Research Institute of Infectious Diseases. The HANAA was delivered to its first users in December 1999. Each generation of our PCR instrumentation has been smaller, lighter, faster, and cheaper than the previous instrument.

Improved Chem/Bio Decontamination

Civilian first-responders have limited methods of chemical or biological decontamination—soap and water or bleach. Through DOE's Chemical and Biological Nonproliferation Program, we are developing a decontamination reagent that is effective against both chemical and biological agents, results in nontoxic byproducts, and is easy to use.

Livermore's L-Gel system is a fumed amorphous silica gel based on the commercial oxidizer oxone (with peroxy-monosulfate as the active

ingredient). L-Gel is noncorrosive and can be applied using a commercially available paint sprayer. It clings to walls and ceilings and does not harm carpets or painted surfaces. Laboratory and field tests over the past two years have demonstrated that L-Gel is effective on various materials found in a civilian setting against all classes of chemical warfare agents, sulfur mustard, all biological surrogates, and live vaccine strains.

Developing Lasers for DoD

In support of the Army's Space and Missile Defense Command, the Laboratory is working with industrial partners to develop a 100-kilowatt (average power) solid-state laser to be deployed on a mobile battlefield platform. Such high-power laser systems are leading candidates for an enhanced air-defense

capability. In 1999, we developed 1.5- and 10-kilowatt prototype lasers and tested their effectiveness in damaging selected materials. We plan to deliver the 10-kilowatt prototype to the High-Energy Strategic Test Facility (HELSTF) at White Sands Missile Range in 2001.